TPC dE/dx Update

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In search of bands…

Now, a few words on looking for things. When you go looking for something specific, your chances of finding it are very bad. Because of all the things in the world, you're only looking for one of them. When you go looking for anything at all, your chances of finding it are very good. Because of all the things in the world, you're sure to find some of them. --Daryl Zero, "The Zero Effect" (1998)

JK's Corollary: When you go looking for a pattern, your chances of finding it are very bad if you have a small statistical sample. Because of all the patterns in the world, you're only looking for one of them. And small statistical samples either hold no patterns or many…
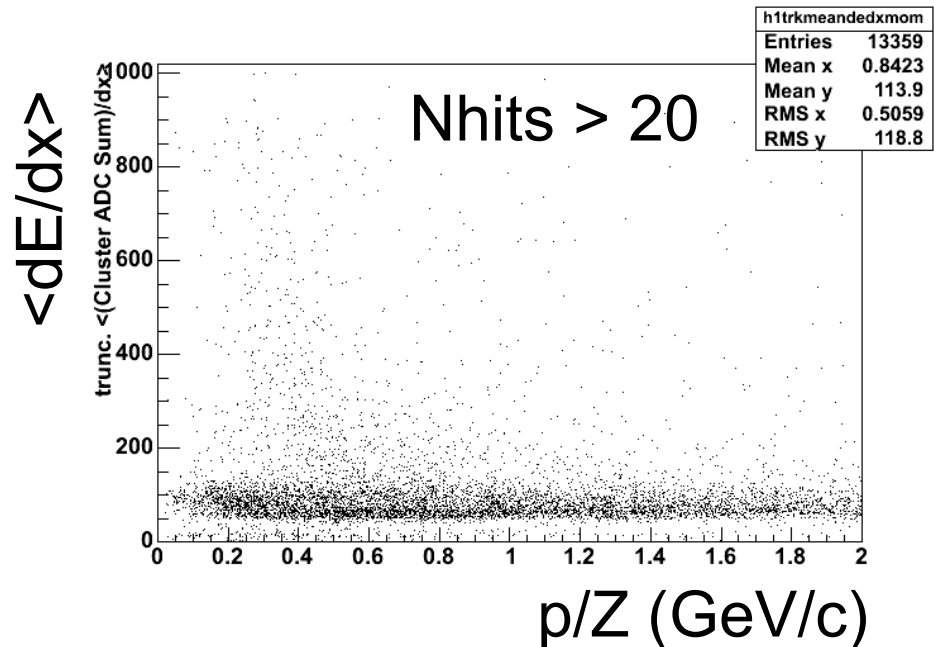
Bear with me, I'm a little punchy…

A pattern
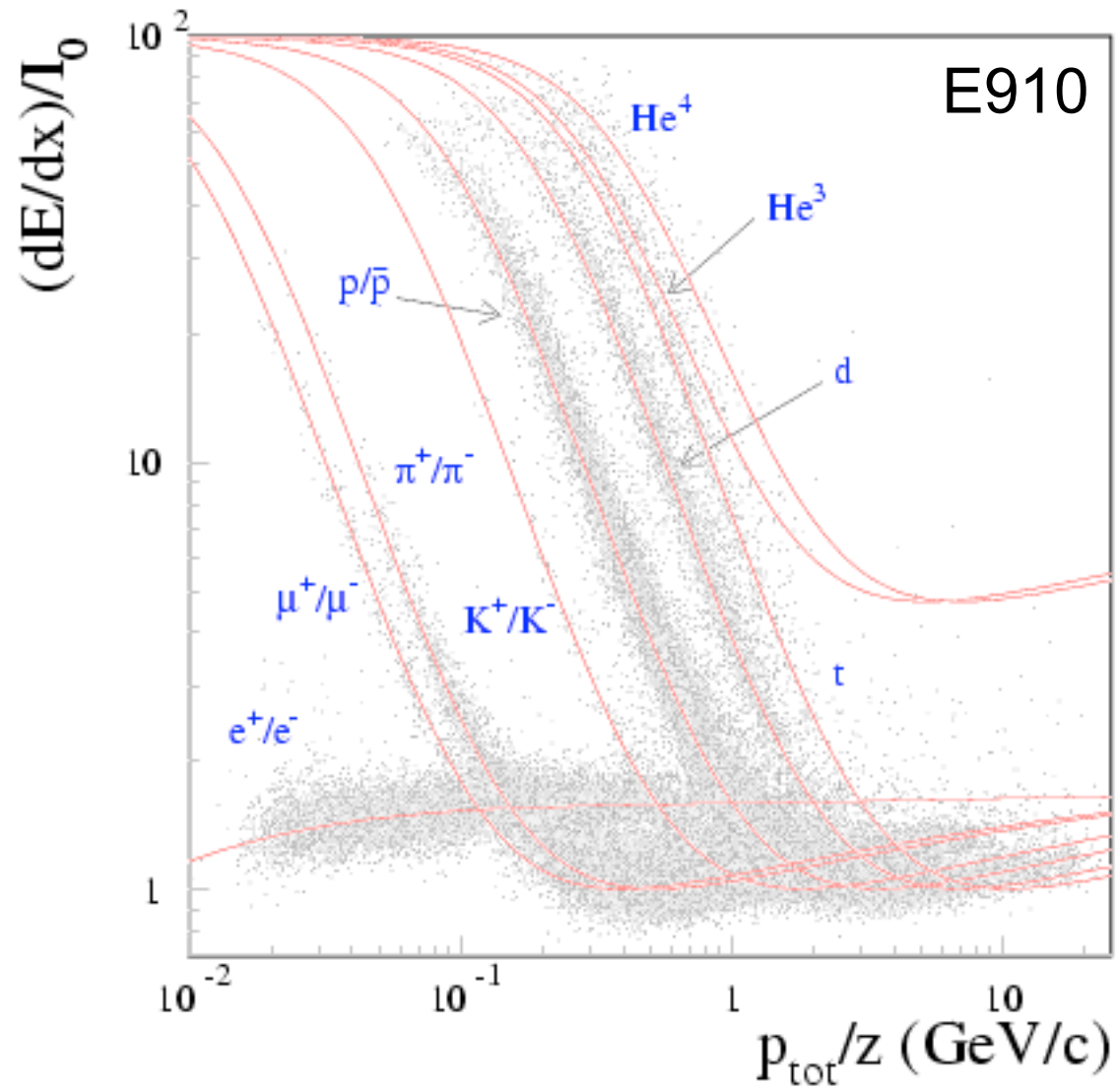
TPC Charge Calibrations

When last we spoke, we couldn't see the bands…

…In a subrun of some randomly chosen run

Nhits > 20

h1trkmeandedxmom	
Entries	13359
Mean x	0.8423
Mean y	113.9
RMS x	0.5059
RMS y	118.8

<dE/dx>

trunc. <(Cluster ADC Sum)/dx>

p/Z (GeV/c)

So…to the farm, and try to generate corrections for
    1. Pad-to-pad Variations
    2. Anode voltage Variations
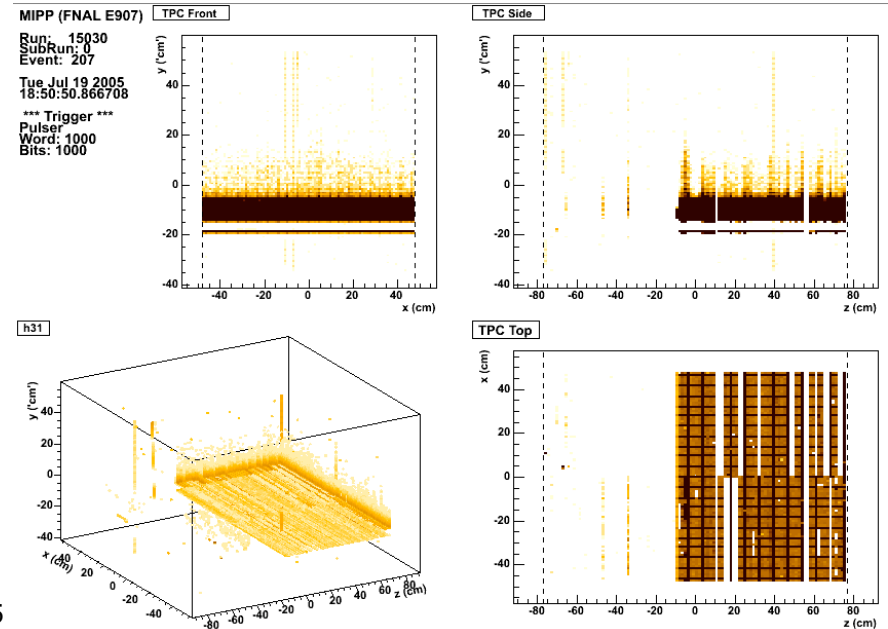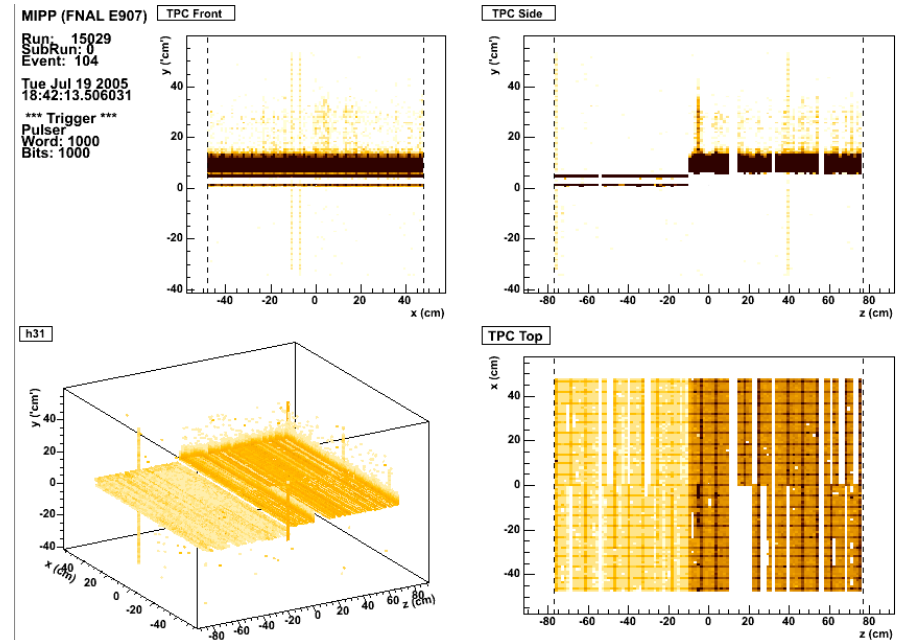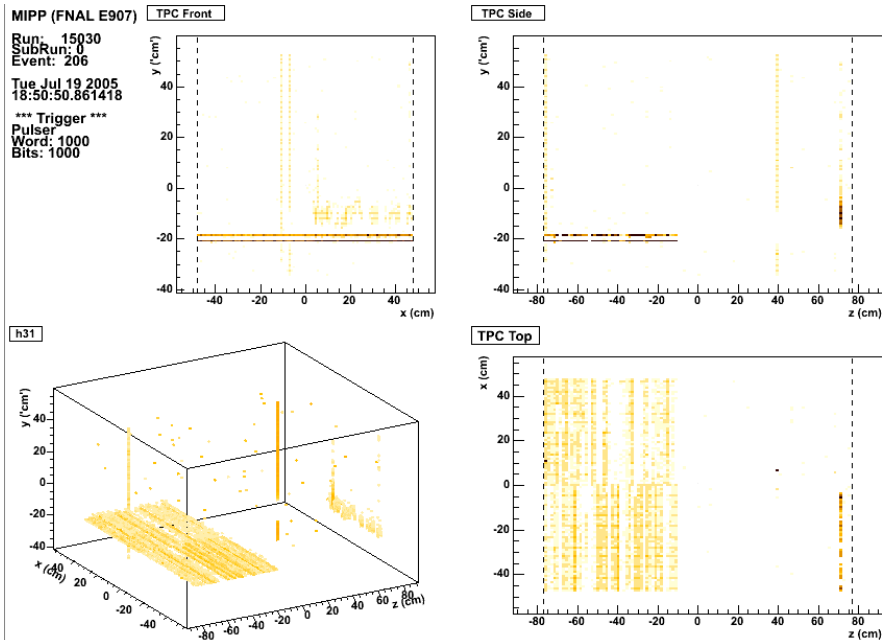   3. Drift Attenuation

GG Pulser

Two gating grid pulser runs

15029 GG Gate set to 7 us
15030 GG Gate set to 3 us
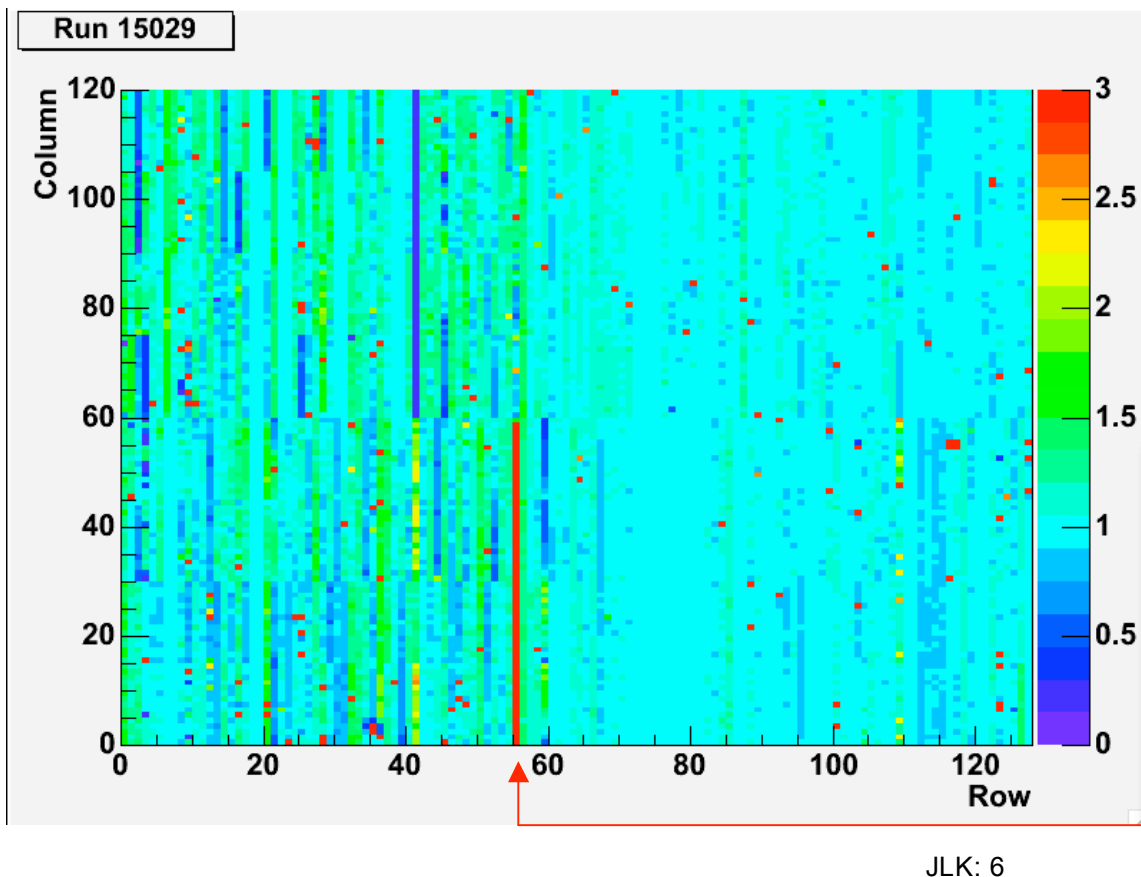(nominal is 20 us)

In 15030, 'every other' pattern:

ILK: 5

Pad-to-pad variations

Code in TPCStudies:

TPCGainAnalysis.cxx, .h, .xml, tpcgain.xml, plotGain.C
(to be checked into CVS)

Each half normalized to
the average ADC value

Row < 56: 90.8408
Row>=56: 720.025

Dead pads set to gain=1
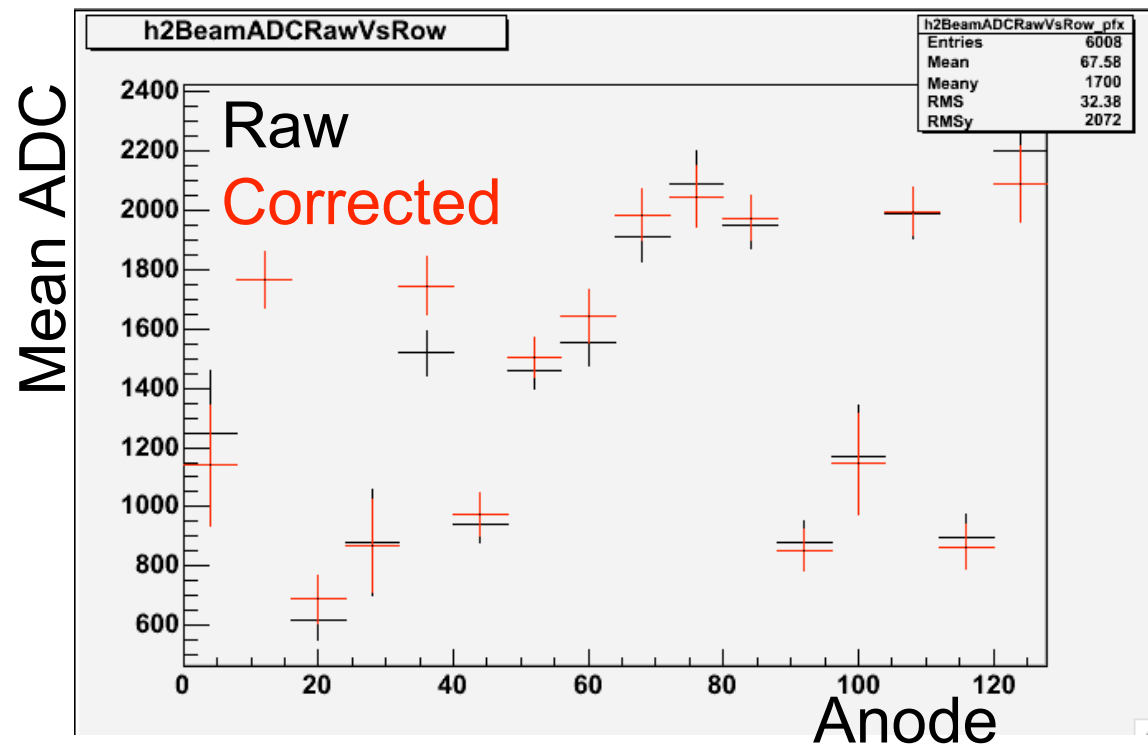
This hot row is questionable.
I renormalized it.

JLK: 6

Application of p2pgain

Run 14029, empty Target, +20 GeV/c

"Beam Track" filter: Event has no vertex and at least
one track with nhits>40 && 16<p<24 GeV/c

Use corrected for
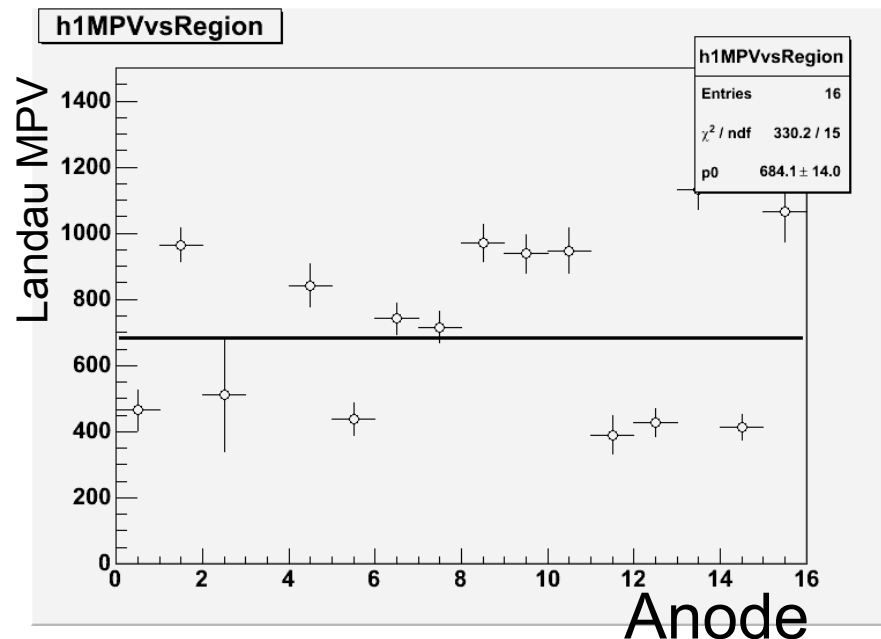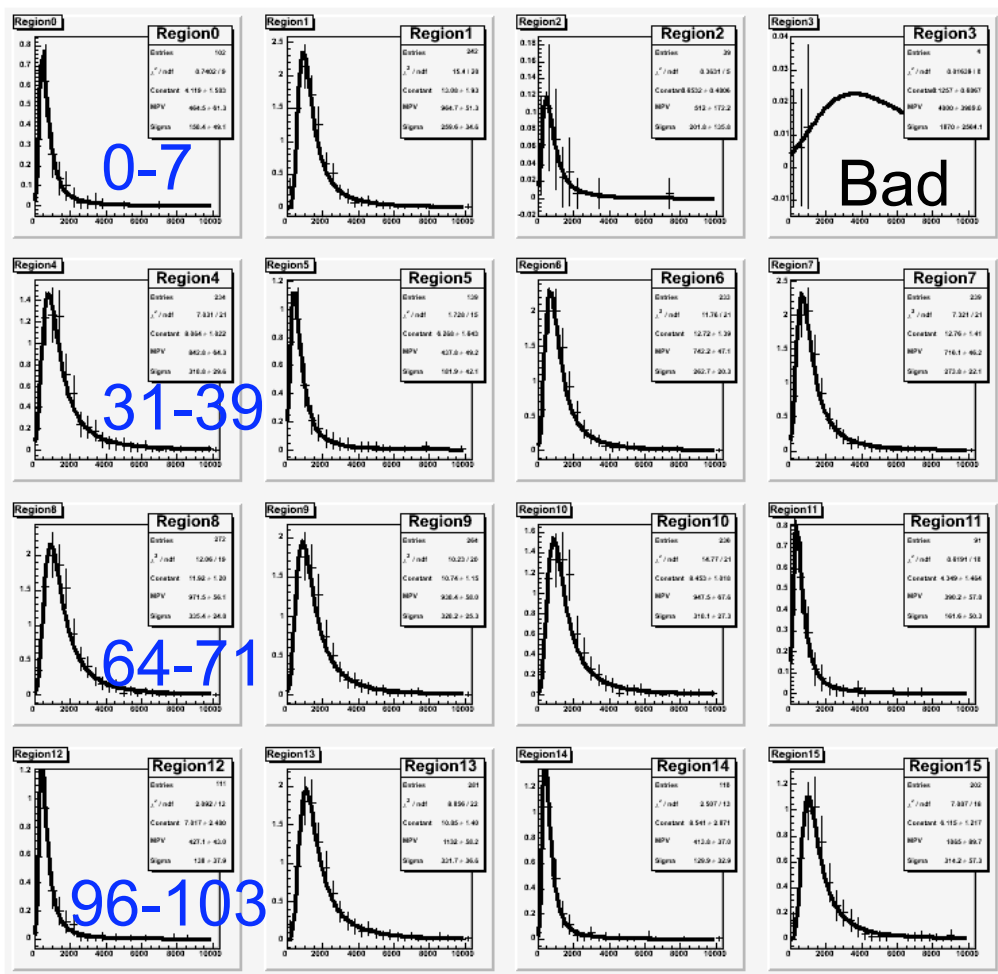anode voltage
variation estimation…

N.B. This is a profile of the distribution - takes the mean ADC
Better: Landau fit and look at variation in most probable value

Anode Voltage Variation

Fit beam track ADCs with Landau, grouping by anode voltage region (8 padrows each)

Mean of all channels = 684

Average of low voltage channels 11,12,14 ~ 400

Run 14029

Anode Voltage Variation II

Run-by-run variations:

20 runs [13996:14046]

30-Apr : 03-May

15 Carbon (247,301)

5 Empty (53,337)

+20 GeV

Anode 0: 471.232
Anode 1: 873.8
Anode 2: 509.643
Anode 3: 421.361
Anode 4: 812.395
Anode 5: 440.987
Anode 6: 661.892
Anode 7: 633.64
Anode 8: 871.888
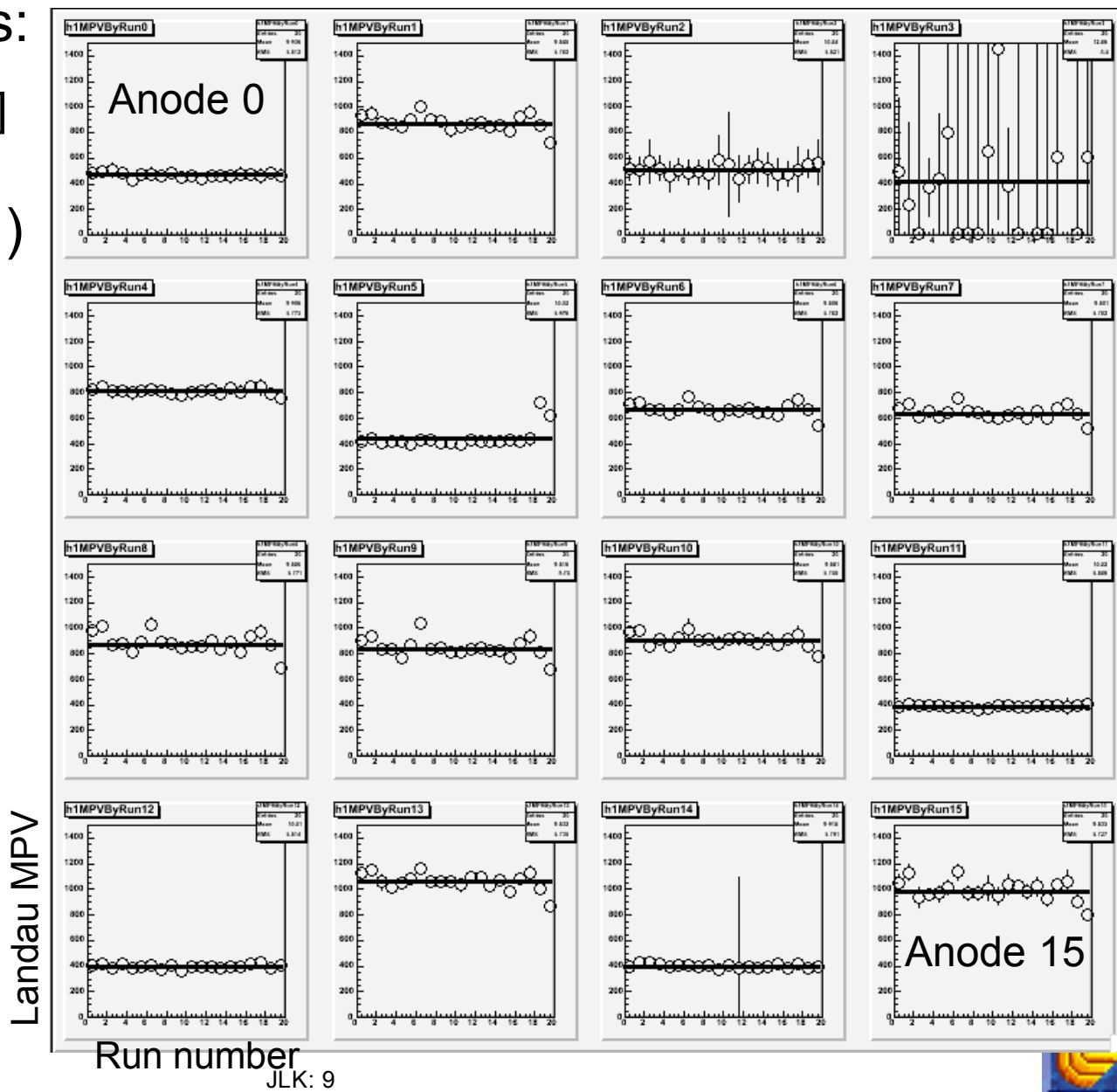Anode 9: 833.613
Anode 10: 900.277
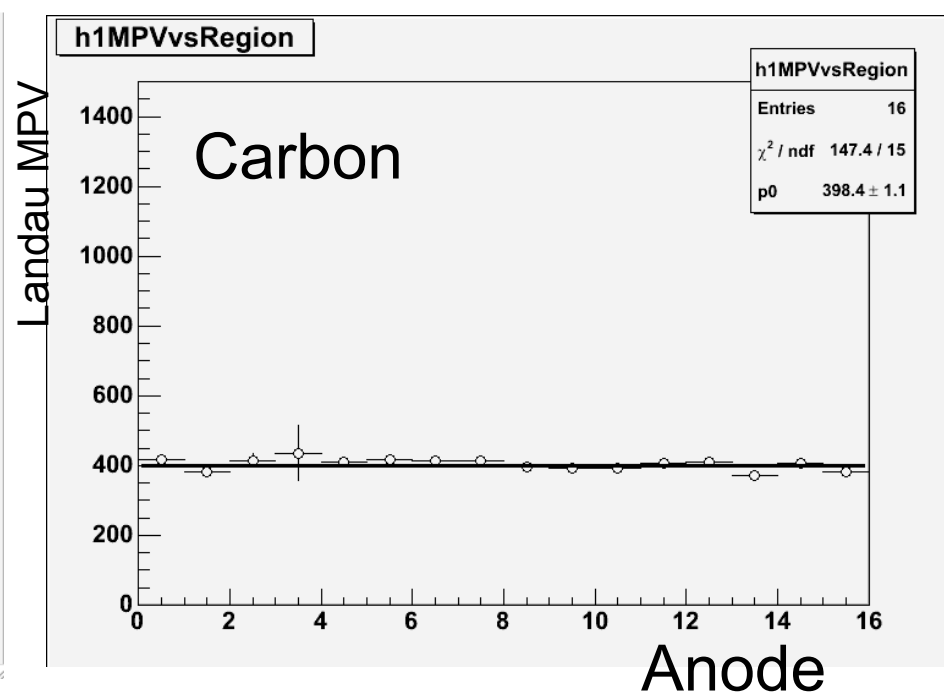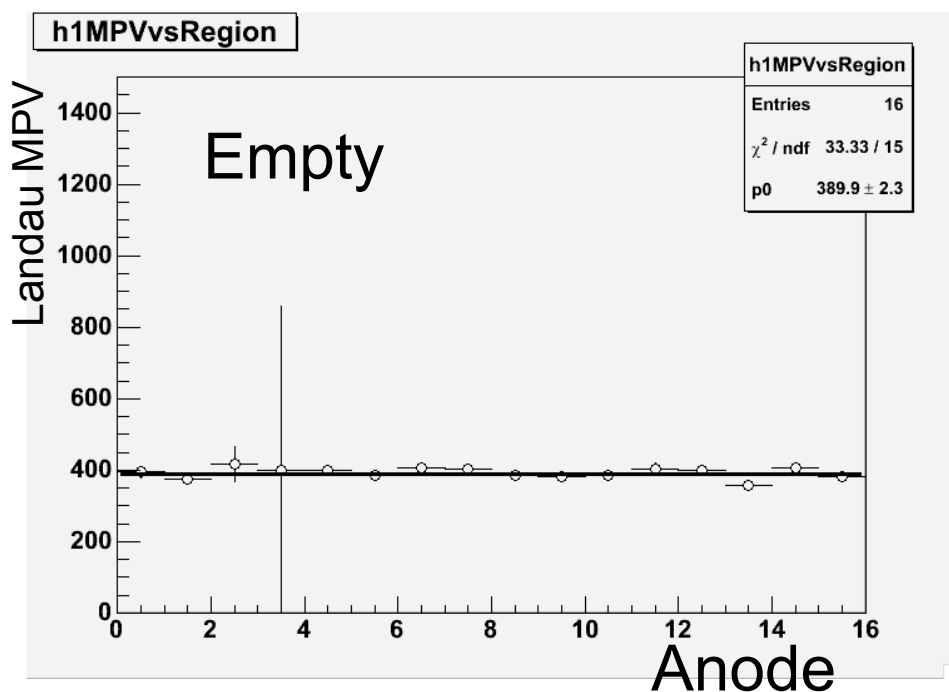Anode 11: 389.603
Anode 12: 398.091
Anode 13: 1058.23
Anode 14: 399.534
Anode 15: 982.27

Landau MPV

Run number

Idiot Check

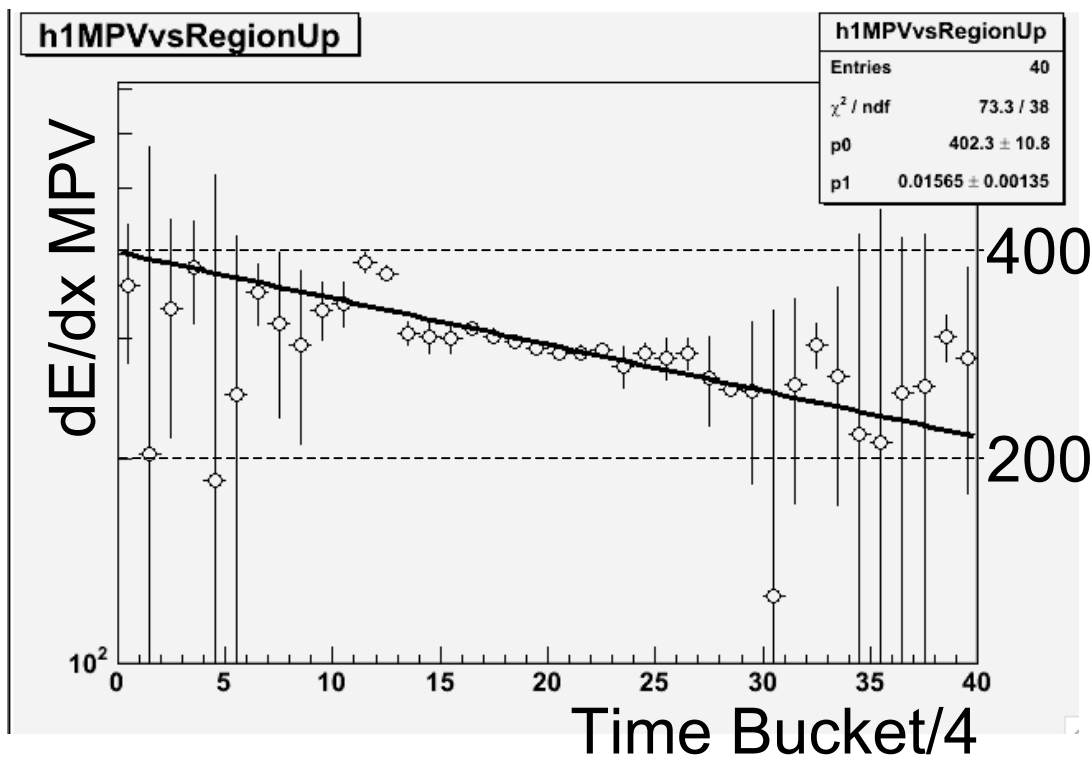Look at the Landau fits for the same beam tracks
after the normalization:

Now look at the dEdx vs bucket for non-beam tracks with nhits >
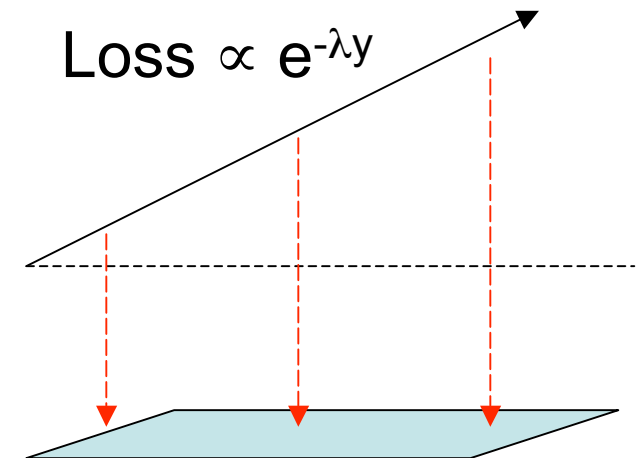20, p>1 GeV/c with ncol<5 and nbkt<15 (isolated clusters)…

Drift attenuation

Most probable value from
Landau fit vs. time bucket region

After correction for P2P and anode voltage variation

Loss $\propto e^{-\lambda y}$

λ = 0.0039
"y" = TimeBucket

(Magboltz estimate of λ ~5x higher)

~50% loss over full
drift distance

Pause

For 93,102 Carbon +20GeV events with a found vertex:

Track rigidity (p/Z) is calculated assuming B = 0.69 T

I currently use dx/dz and dy/dz to calculate "dx" for cluster

I use only "isolated" clusters (npads<5 && nbkts < 15)
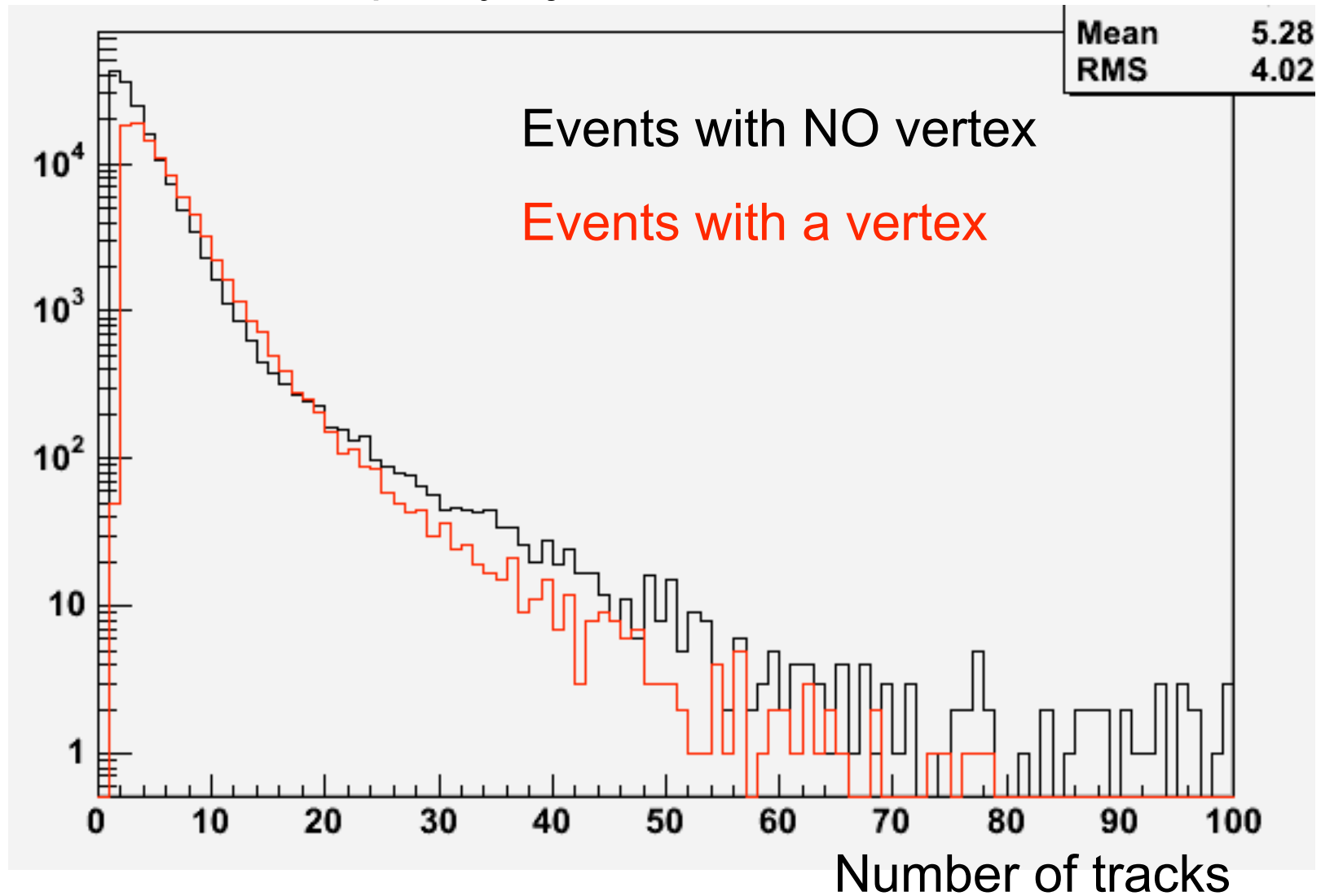
Remove bottom 5% and top 30% of cluster dE/dx samples

Only plot for tracks with nhits > 20

N.B. out of 247,301 triggers, 93,102 were events with a vertex, 154,199 had at least one track but no vertex, of which 76,830 had 3 or more tracks
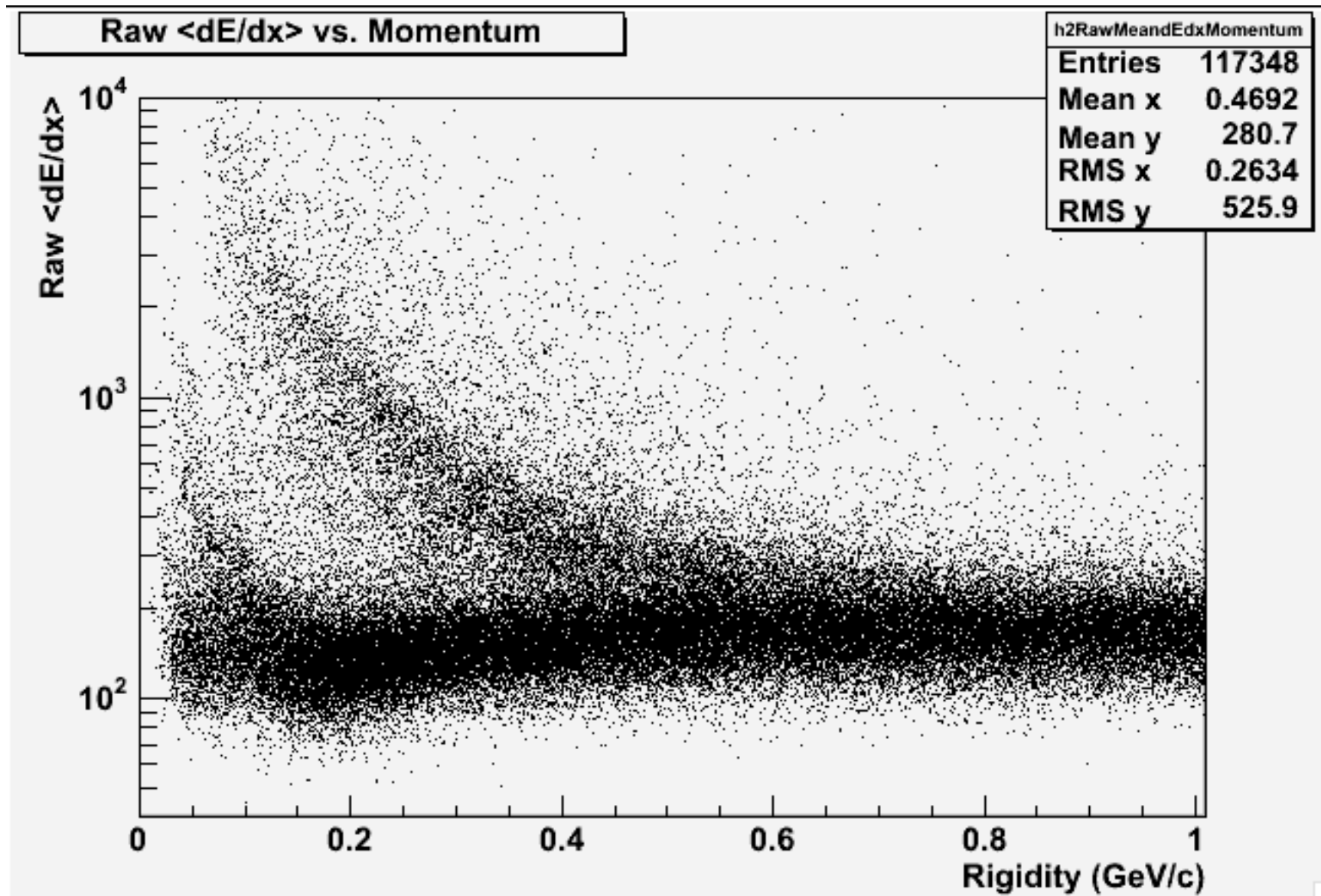
Ntrack distributions

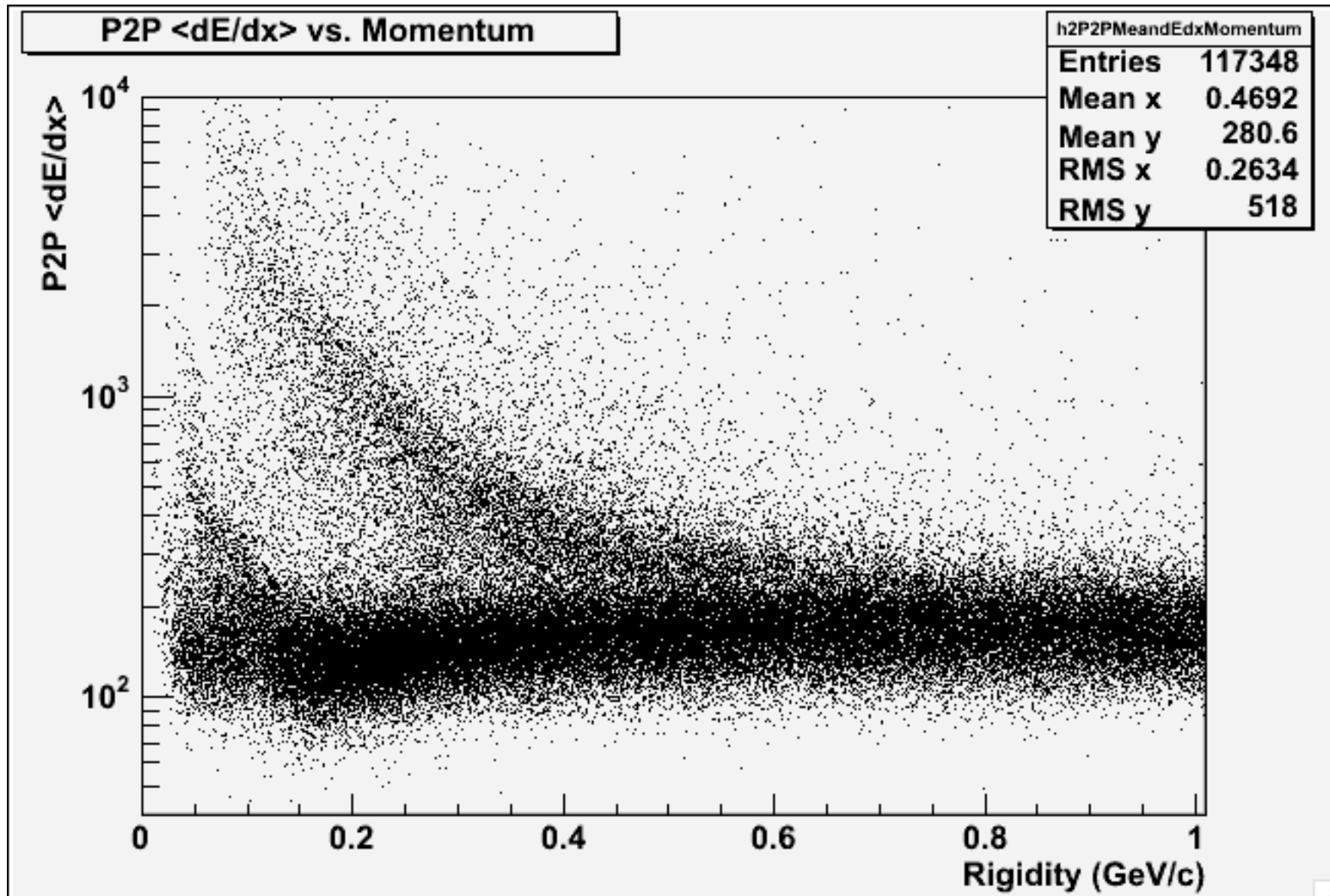No cuts on track quality - just the tracklist size for each event

Mean 5.28
RMS 4.02

Events with NO vertex

Events with a vertex

Number of tracks

Drum roll, please…

Raw <dE/dx>

Raw <dE/dx> vs. Momentum

h2RawMeandEdxMomentum	
Entries	117348
Mean x	0.4692
Mean y	280.7
RMS x	0.2634
RMS y	525.9

P2P Corrected <dE/dx>

Anode V Corrected <dE/dx>

AVV <dE/dx> vs. Momentum

h2AVVMeandEdxMomentum	
Entries	117348
Mean x	0.4693
Mean y	183.6
RMS x	0.2634
RMS y	427

y-axis: AVV <dE/dx>

x-axis: Rigidity (GeV/c)
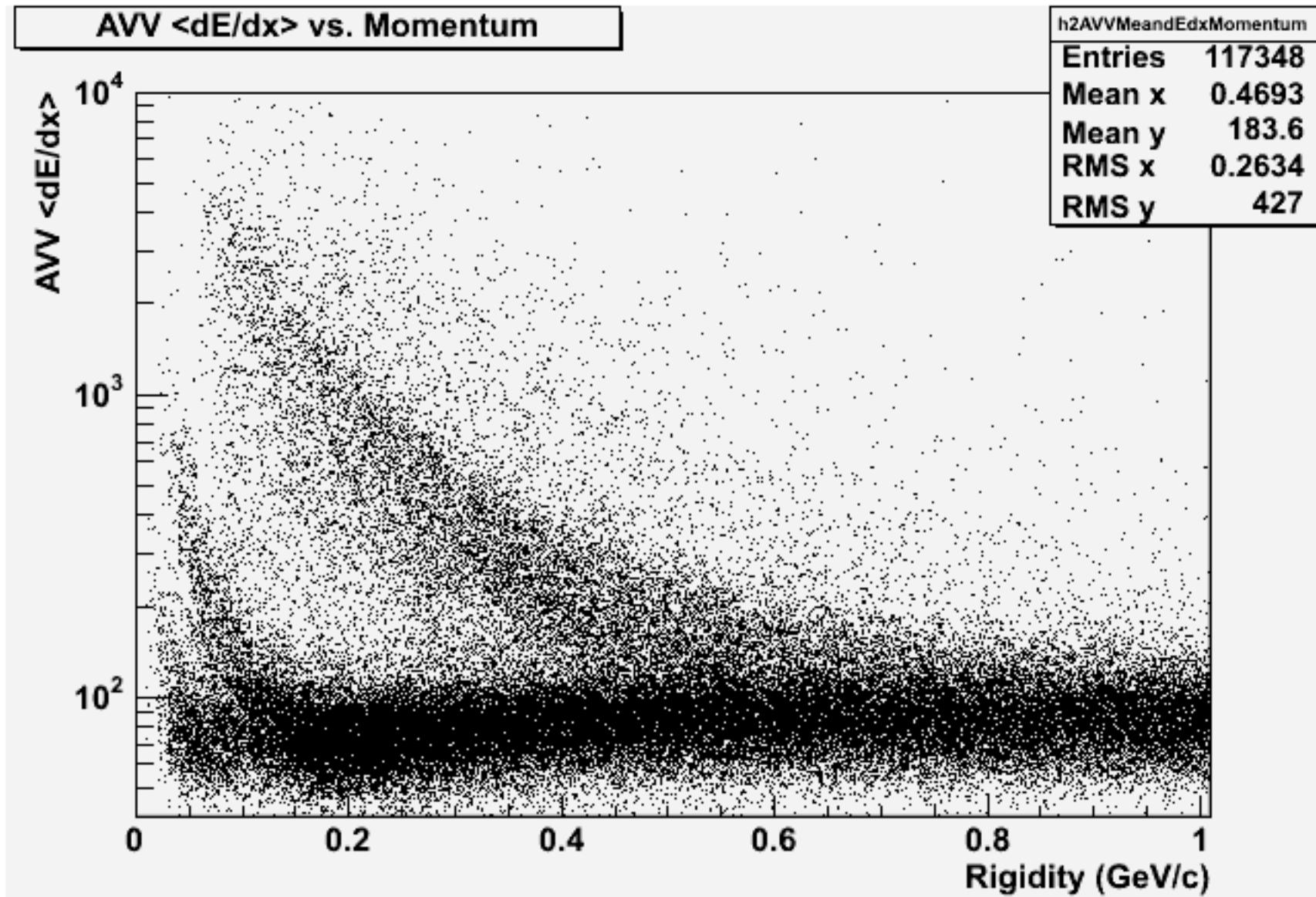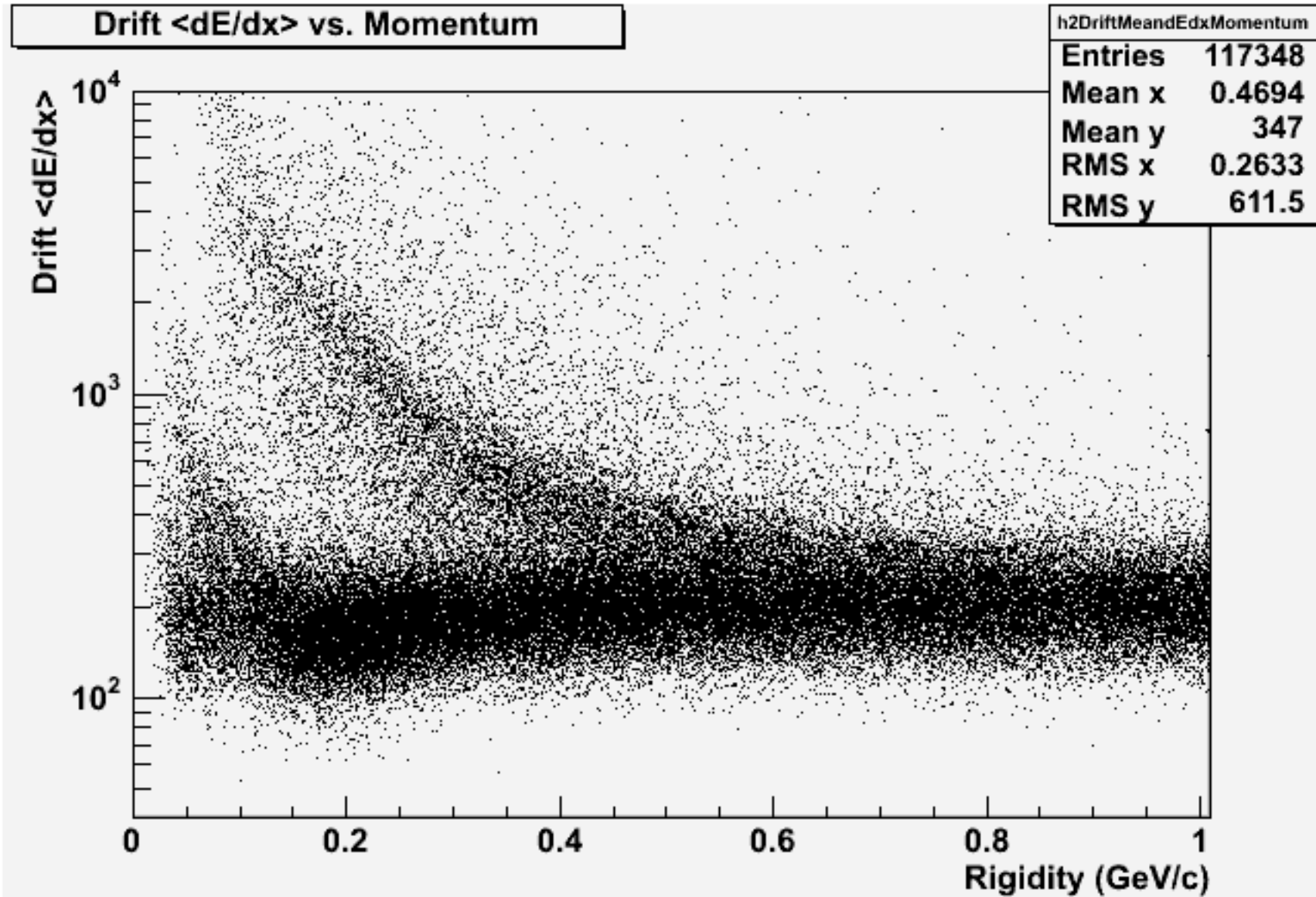
Drift Corrected <dE/dx>

P2P and Drift Corrected <dE/dx>

P2P and AVV Corrected <dE/dx>

AVV+Drift Corrected <dE/dx>

AVV+Drift <dE/dx> vs. Momentum

h2AVVDriftMeandEdxMomentum	
Entries	117348
Mean x	0.4692
Mean y	227.7
RMS x	0.2634
RMS y	503.8
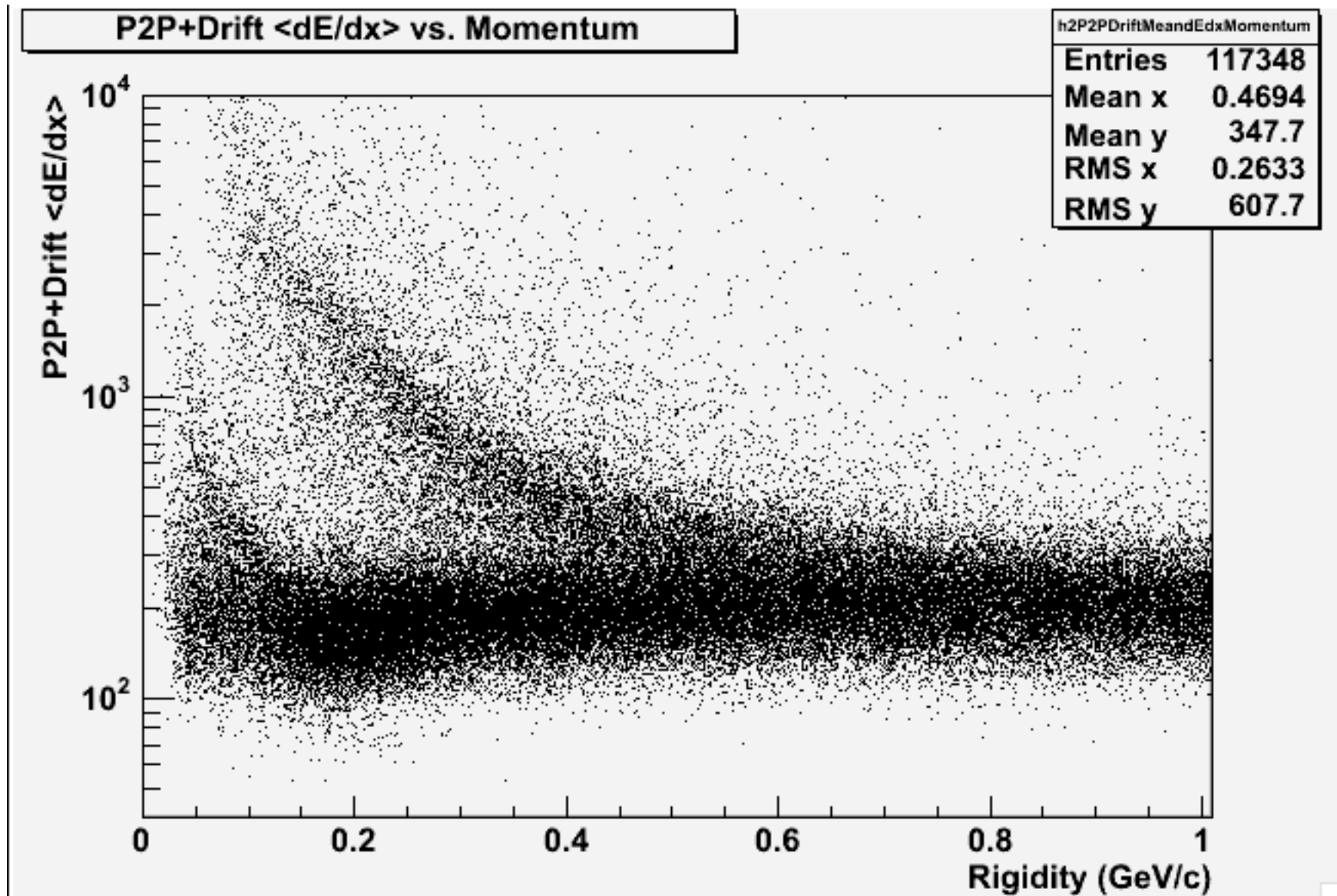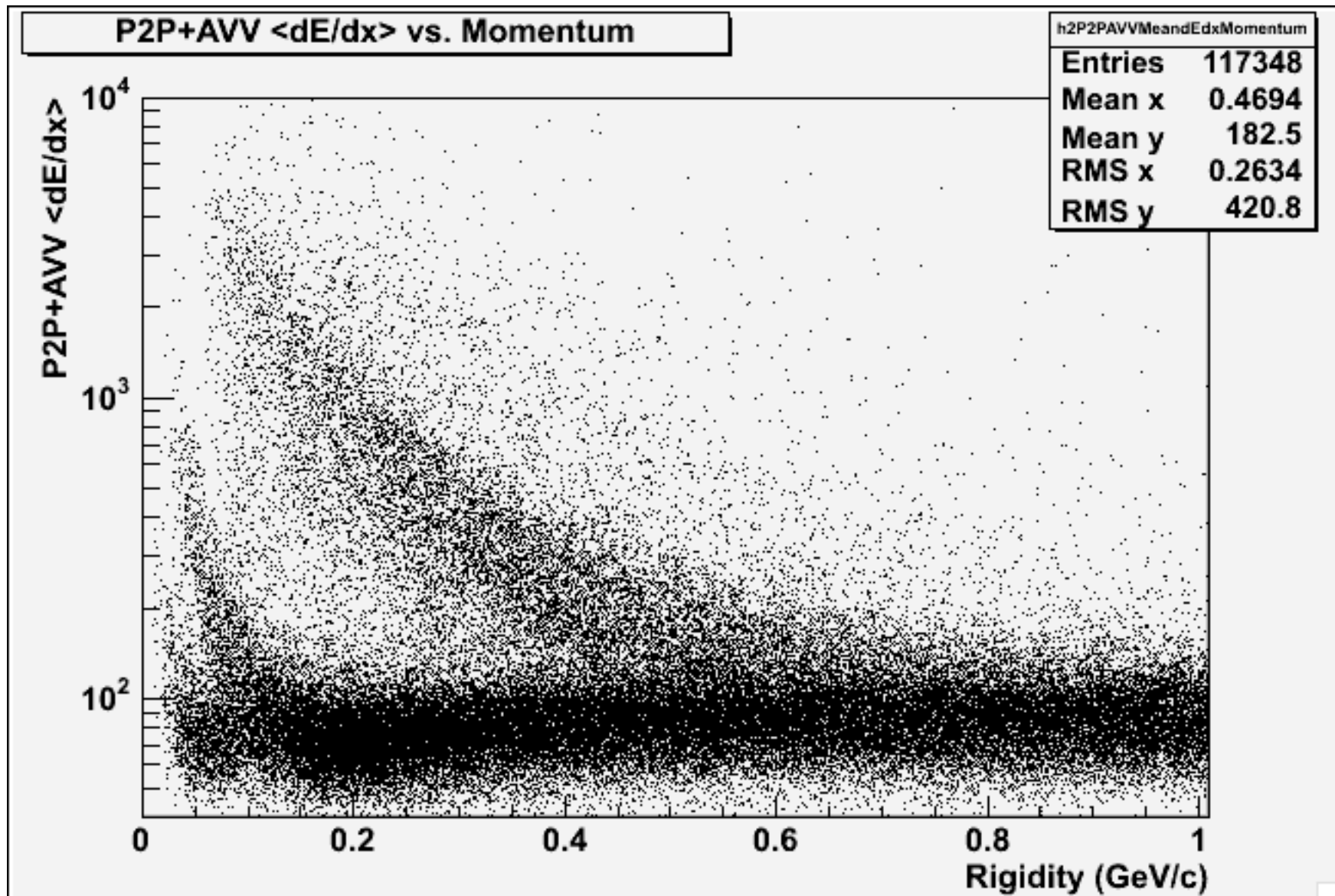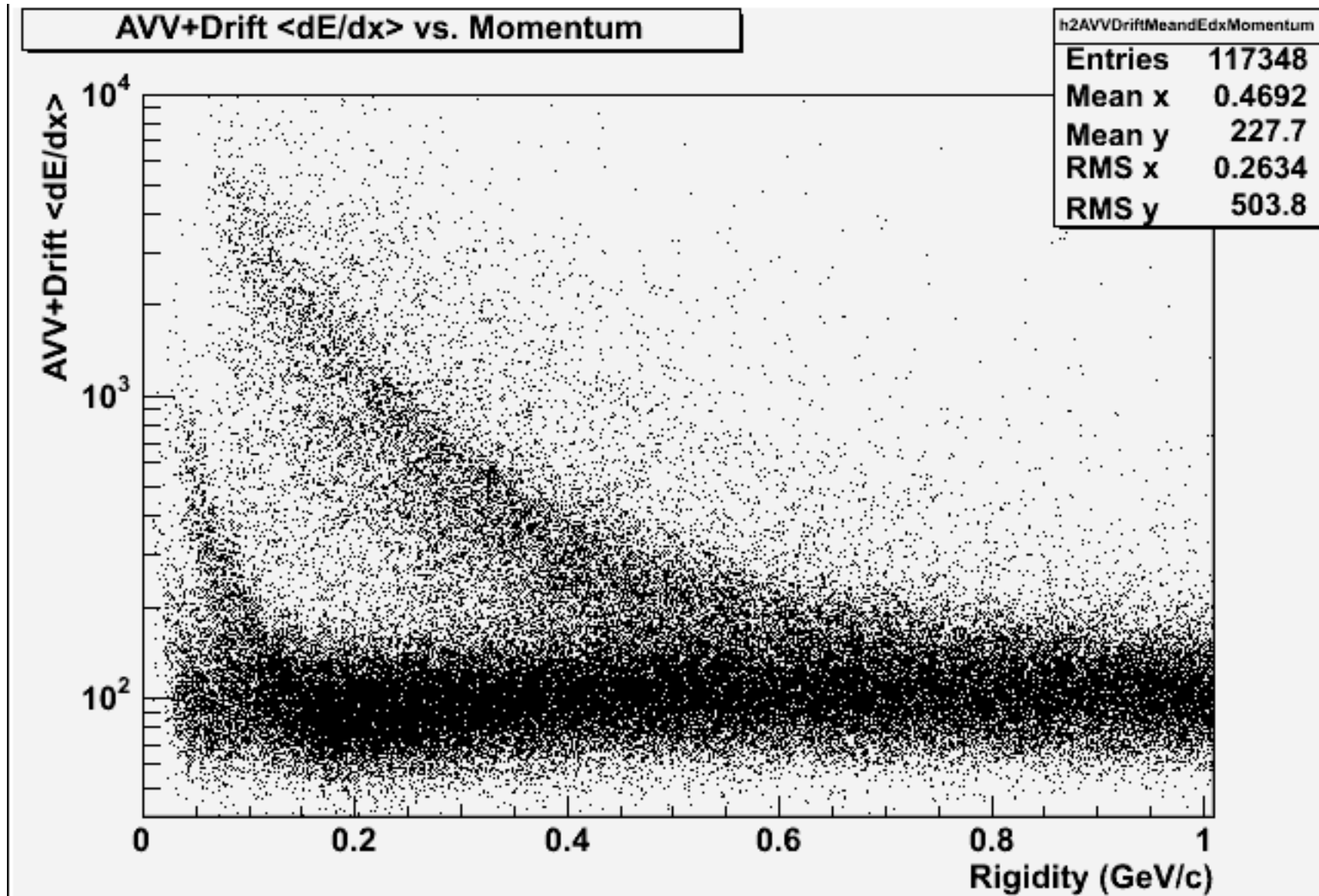
All Corrections <dE/dx>
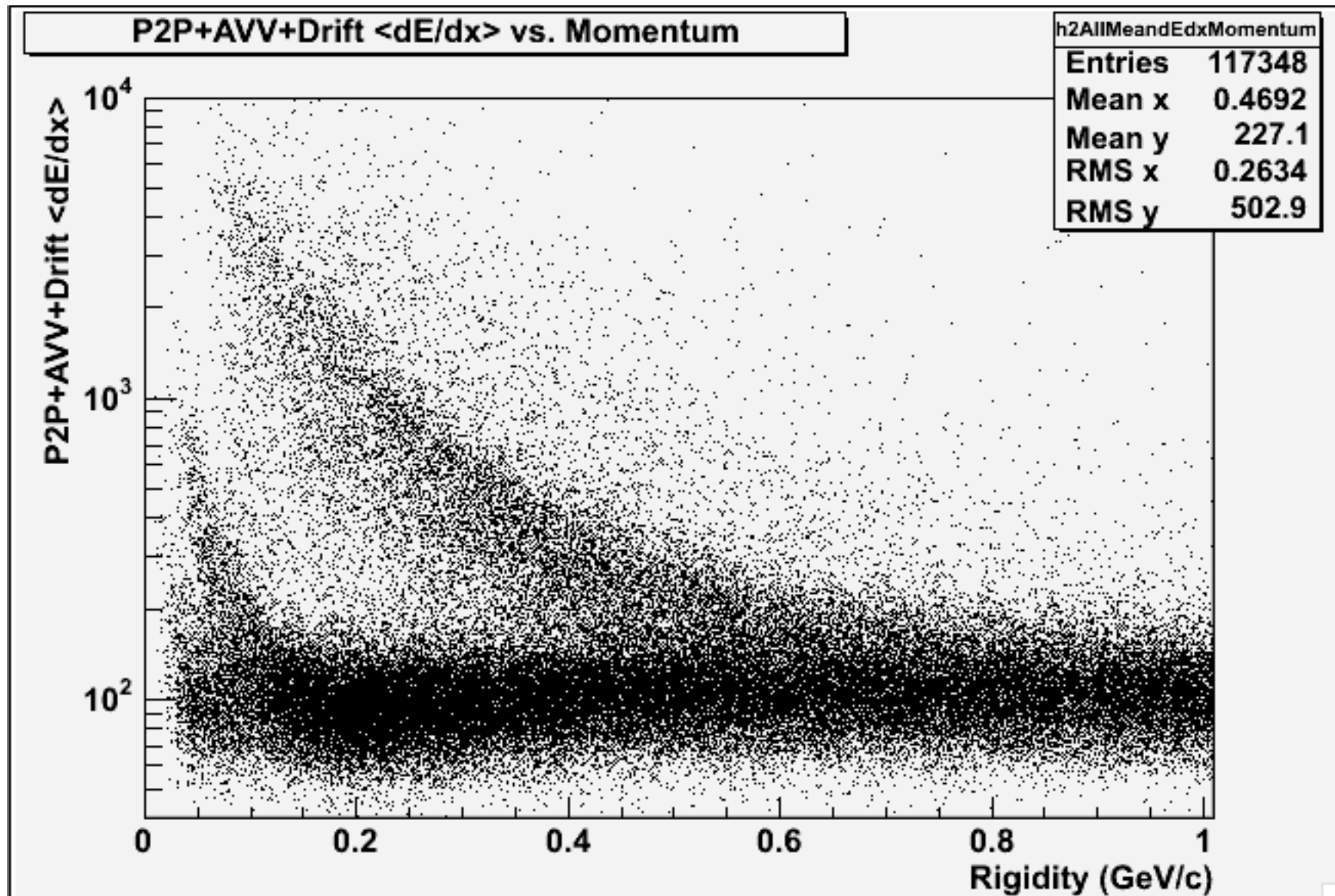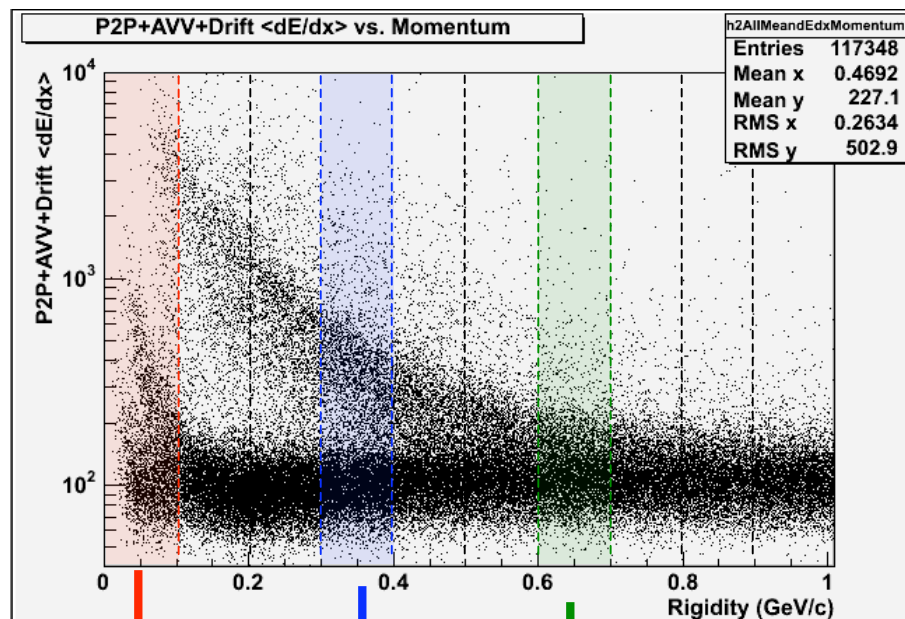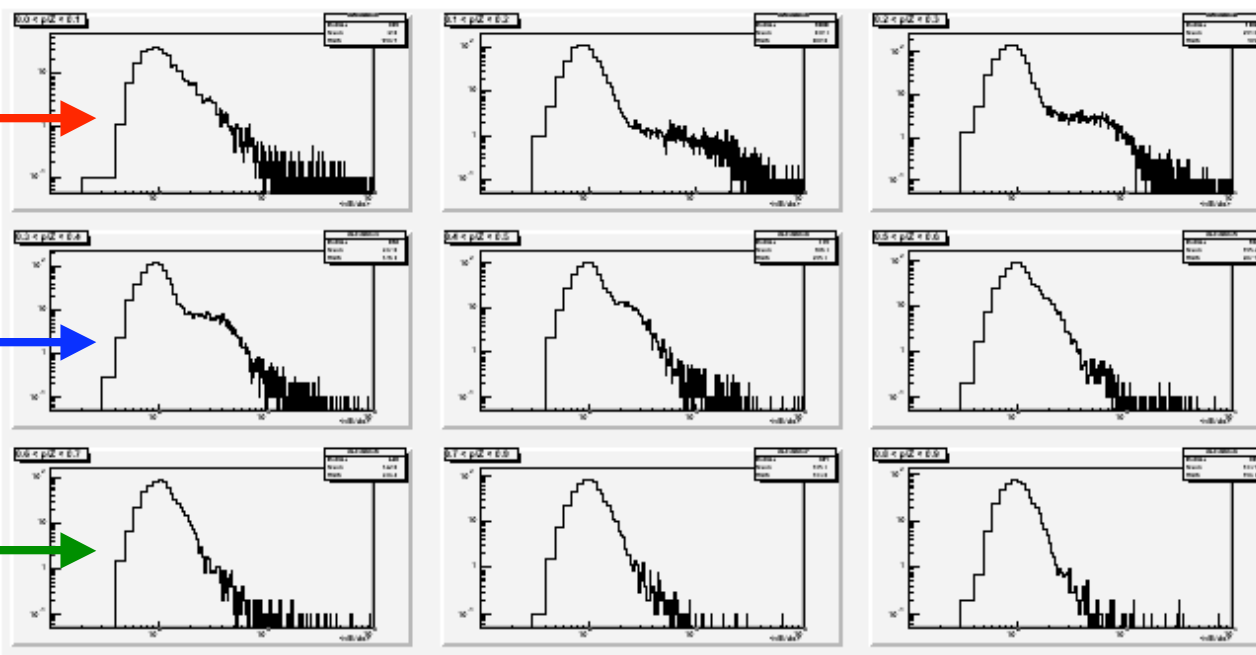
We're on our way…
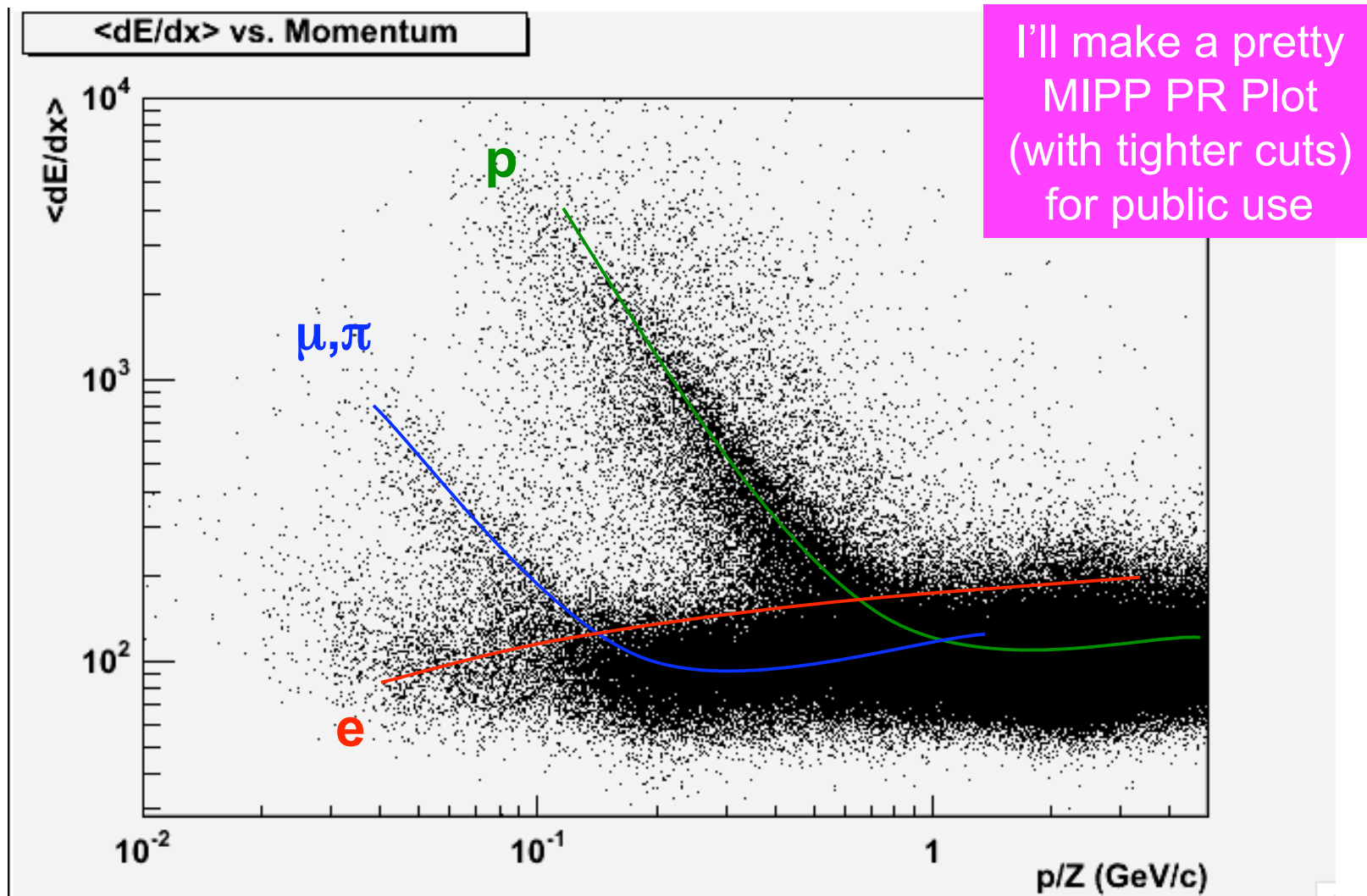
Artist's rendition of the Bethe-Bloch curves - not a real calculation

Toward Physics…

Coming soon…
Fit slices in rigidity to get
PID'ed momentum spectra

Some to-dos…

Look at some more runs to map out systematics

     -Different voltages

     -O_2 contamination variation

     -Temperature, pressure

     -Etc.

Write a calibration module to analyze above and decide what parameters to add to db

Improve <dE/dx> resolution

     Cluster fitting

     Truncation optimization

Improve momentum resolution (for Jon)

Fin

Thus ends the case of the physicist who got stressed out because she couldn't find the dE/dx bands when Howard Wieman[†] said they should be there in the raw data and they were there all along only she didn't look at enough events.*

†Father of EOS TPC

*Or maybe a bad subrun